


# Fix or Replace? Patient Preferences for the Treatment of Geriatric Lower Extremity Fractures: A Discrete Choice Experiment

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## Abstract

**Introduction:** When considering treatment options for geriatric patients with lower extremity fractures, little is known about which outcomes are prioritized by patients. This study aimed to determine the patient preferences for outcomes after a geriatric lower extremity fracture. **Materials and Methods:** We administered a discrete choice experiment survey to 150 patients who were at least 60 years of age and treated for a lower extremity fracture at a Level I trauma center. The discrete choice experiment presented study participants with 8 sets of hypothetical outcome comparisons, including joint preservation (yes or no), risk of reoperation at 6 months and 24 months, postoperative weightbearing status, disposition, and function as measured by return to baseline walking distance. We estimated the relative importance of these potential outcomes using multinomial logit modeling. **Results:** The strongest patient preference was for maintained function after treatment (59%,  $P < .001$ ), followed by reoperation within 6 months (12%,  $P < .001$ ). Although patients generally favored joint preservation, patients were willing to change their preference in favor of joint replacement if it increased function (walking distance) by 13% (SE, 66%). Reducing the short-term reoperation risk (12%,  $P < .001$ ) was more important to patients than reducing long-term reoperation risk (4%,  $P = .33$ ). Disposition and weightbearing status were lesser priorities to patients (9%,  $P < .001$  and 7%,  $P < .001$ , respectively). **Discussion:** After a lower extremity fracture, geriatric patients prioritized maintained walking function. Avoiding short-term reoperation was more important than avoiding long-term reoperation. Joint preservation through fracture fixation was the preferred treatment of geriatric patients unless arthroplasty or arthrodesis provides a meaningful functional benefit. Hospital disposition and postoperative weightbearing status were less important to patients than the other included outcomes. **Conclusions:** Geriatric patients strongly prioritize function over other outcomes after a lower extremity fracture.

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## Keywords

geriatric trauma, foot and ankle surgery, trauma surgery, geriatric medicine, adult reconstructive surgery

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## Introduction

The incidence of geriatric fractures will continue to increase as the United Nations estimates 1 in 6 people in the world will be over the age of 65 years by the year 2050.<sup>1</sup> With poor bone quality and limited healing potential, the optimal treatment of many geriatric fractures remains unknown.<sup>2-12</sup> Arthroplasty or arthrodesis can provide a reasonable alternative to traditional fixation strategies for the treatment of certain geriatric lower extremity fractures.<sup>2-12</sup> Arthroplasty remains the gold standard for the treatment of displaced geriatric intracapsular hip fractures.<sup>13-16</sup> Arthroplasty or arthrodesis has been studied for the treatment of other geriatric fracture patterns including the acetabulum, distal femur, and certain severe ankle fractures, particularly in poor hosts or severe injuries. These alternative treatment strategies can provide the opportunity for earlier weightbearing and earlier mobilization but often come with their own unique set of potential complications.<sup>2-8,12</sup> When considering surgical treatment options in this geriatric patient population, little is known about which outcomes are prioritized by patients.

Discrete choice experiments are a well-validated method for quantifying patient preferences.<sup>17-21</sup> In this approach, patients are presented with a series of competing hypothetical scenarios with varying levels of a fixed set of attributes. By aggregating patients' responses, we can then calculate the relative importance of each included attribute and acceptable trade-offs among attributes.<sup>17-21</sup>

The primary aim of our study was to use this technique to determine which outcomes are most important to geriatric patients when faced with a lower extremity fracture. We hypothesized that patients would prioritize function over joint preservation and other outcomes.

## Methods

### Study Design

We conducted a discrete choice experiment to quantify the relative importance of outcomes and variation in preferences among geriatric patients when faced with a lower extremity fracture. The study was performed at a single academic Level I trauma center from November 2021 through April 2022. The Institutional Review Board reviewed and approved the study.

### Study Population


The study enrolled orthopaedic trauma patients, age  $\geq 60$  years, who presented for outpatient follow-up. Patients were approached during their outpatient appointment and surveys were administered by research assistants. All patients who had the capacity to comprehend and complete the survey were eligible for participation. Patients presenting for both upper and lower extremity injuries were included. Patients were excluded from participation in the study if they were unable to speak or read English, or lacked the mental status to comprehend or complete the survey. Relatives or guardians of the patient could not complete the survey on their behalf.

### Survey Development

We identified 6 patient important outcomes through a literature review, expert opinion, and pilot testing. These outcomes, also referred to as attributes, included joint preservation (yes or no), risk of reoperation at 6 months and 24 months ranging from 5% to 15%, postoperative weightbearing status (immediate vs 6 weeks), disposition (home vs rehabilitation facility), and function. Risk of reoperation was divided into early and late as separate attributes because these often represent different procedures and may be prioritized differently to patients. The outcome of function was quantified for our study by the distance the patient could walk following recovery at 6 months compared to their preoperative level. This outcome provided a simple objective and easily comprehended measurement of function that was applicable to patients of all functional levels. Mortality was evaluated as a potential attribute and excluded over concern it would limit the evaluation of other attributes because of the overwhelming preference of decreasing mortality by patients reported in previous studies.<sup>19</sup>

Using the Choice Design platform in JMP Pro Version 14 (SAS, Cary, NC), we created 24 orthogonal choice sets (Figure 1). The 24 choice sets were stratified into three different versions of the survey. Consenting patients were randomly assigned to complete one version to limit respondent burden.

In each choice set, patients were presented with two possible outcome scenarios of a hypothetical lower extremity fracture that could be treated with internal fixation or a joint sacrificing procedure, such as arthroplasty or arthrodesis, and asked to select their preferred outcome

Scenario 5: Of these two options, which do you prefer? Check <b>one</b> option.		
	Option A	Option B
You keep your own joint	No	Yes
Chance you will need another surgery at 6 months	5%	40%
Chance you will need another surgery at 2 years	5%	15%
When you can put weight on leg after surgery	6 weeks	Immediately
Where you go when you leave hospital	Home	Rehabilitation center for 4 weeks
How far you can walk 6 months after the injury compared to before injury (percentage)	50%	80%
Check one 	Prefer Option A <input type="checkbox"/>	Prefer Option B <input type="checkbox"/>

**Figure 1.** Example scenario from discrete choice experiment.

scenario. We also collected patient demographic and clinical characteristics, including the Patient-Reported Outcomes Measurement Information System (PROMIS) Global-10 assessment to evaluate general health and function.

### Statistical Analysis

There is no consensus on the best approach for determining the required sample size for a discrete choice experiment.<sup>22,23</sup> One approach, described by de Bekker-Grob et al., determines the sample size by multiplying 500 by the maximum number of levels in the included attributes (3 in our study) divided by the product of the number of choice sets completed by each respondent (8) and the number of comparisons in each choice set (2), implying 125 respondents provided sufficient power for the main effect analysis.<sup>22</sup> In their review, Johnson et al. conclude that discrete choice experiment estimation precision increases rapidly as sample sizes approach 150 respondents.<sup>23</sup> Based on these calculations, we sought to enroll 150 patients.

We described the demographic and clinical characteristics of the respondents using means with standard deviations or medians with interquartile ranges for continuous variables and frequencies with proportions for categorical variables. The relative importance of the attributes and the preference weight for each attribute level

was estimated using multinomial logit modeling. The *P*-value reported for our relative importance estimates represent the probability of zero importance for the given attribute. The preference weights for each attribute were mean centered to zero and reported on a standard, linear scale. Preference weights do not have a direct interpretation but, rather, are comparable within and between the included attributes. A higher value indicates a greater preference for a given attribute level. We calculated acceptable trade-off for joint preservation by dividing the difference in joint preservation preference weight levels by a one unit change in walking distance preference weight levels. To evaluate variation in preferences, we independently tested each of the described characteristics as an interaction term in the multinomial logit model. Our threshold for a significant interaction was set to  $P < .05$ . We completed the statistical analysis using JMP Pro Version 14 (SAS, Cary, NC) and R Version 4.0.2 (R Foundation for Statistical Computing, Vienna, Austria).

### Results

One hundred fifty patients were consented and enrolled in the study. The median age was 69.8 years (standard deviation 7.2), 58% were male, and 63% had additional education after high school (Table 1). The majority of patients were White (75%). Nearly one third of patients had a previous joint replacement or fusion procedure.

**Table 1.** Patient Characteristics.

Characteristic	N = 150
Age, years, mean (SD)	69.8 (7.2)
Sex	
Male	87 (58%)
Female	63 (42%)
Race	
White	112 (75%)
Black	32 (21%)
Other <sup>a</sup>	6 (4%)
Educational attainment <sup>b</sup>	
High school or less	54 (37%)
Some college, no degree	34 (23%)
Associate's or bachelor's degree	34 (23%)
Graduate or professional degree	25 (17%)
Working prior to injury <sup>c</sup>	
Yes	27 (18%)
No	49 (33%)
Retired	73 (49%)
Prior joint replacement or fusion procedure	42 (28%)
Have stayed in nursing home or rehabilitation facility	84 (56%)
Full health insurance coverage	145 (97%)
Able to walk 1 mile before injury	101 (67%)
Aided ambulation before injury <sup>d</sup>	24 (16%)
PROMIS physical health, median (IQR)	43 (39, 48)
PROMIS mental health, median (IQR)	52 (43, 60)

<sup>a</sup>Contains 3 of mixed race, 1 of American Indian/Alaska Native race, 1 of Hispanic, and 1 who preferred not to answer.

<sup>b</sup>Three patients preferred not to respond.

<sup>c</sup>One patient preferred not to respond.

<sup>d</sup>One patient preferred not to respond.

**Table 2.** Relative Importance of Included Attributes.

Attribute	Importance(%)	P-Value
Walking distance at 6 months relative to pre-injury	59	<.001
Reoperation within 6 months	12	<.001
Joint preservation	10	<.001
Disposition	9	<.001
Immediate weightbearing	7	<.001
Reoperation within 24 months	4	.33

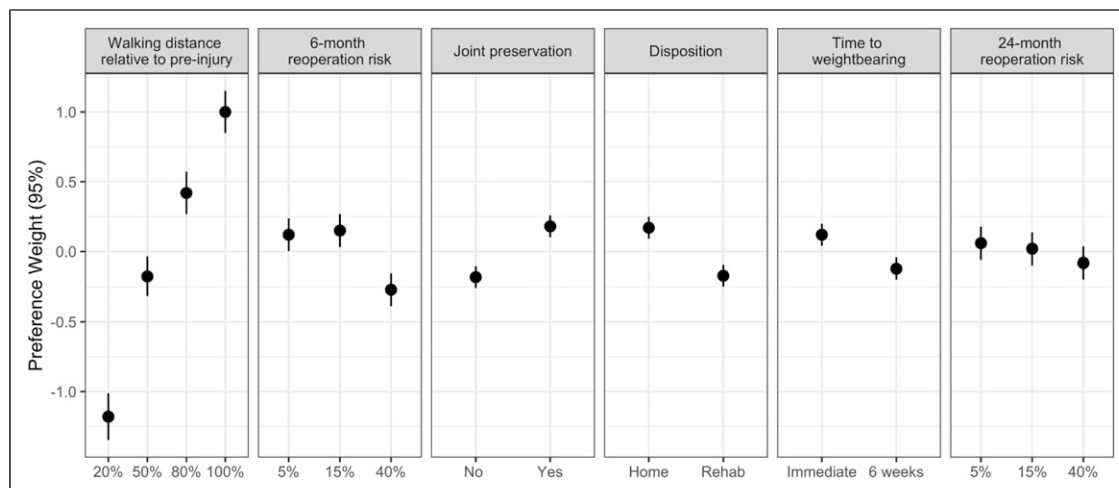
Note: P-value is the probability that the importance of a given attribute is zero.

Sixty-seven percent of patients reported being able to walk at least 1 mile before the injury. Among respondents, the median PROMIS mental health score was similar to the US population (median, 52; interquartile range [IQR], 43 to 60), and the median PROMIS physical health score was nearly a standard deviation below the US population (median, 43; IQR, 39 to 48).<sup>24</sup>

The strongest patient preference was for maintained function after treatment (59%,  $P < .001$ ), followed by reoperation within 6 months (12%,  $P < .001$ ) and joint

preservation (10%,  $P < .001$ ) (Table 2). Reducing the short-term reoperation risk (12%,  $P < .001$ ) was more important than reducing long-term reoperation risk (4%,  $P = .33$ ). Disposition and weightbearing status were lesser priorities (9%,  $P < .001$  and 7%,  $P < .001$ , respectively). Long-term reoperation risk (4%,  $P = .33$ ) was the least prioritized outcome evaluated.

The relative preference weights for each of the attributes are detailed in Figure 2. Regaining 100% function and 80% function were the two most desirable outcomes [preference



**Figure 2.** Preference weights for each attribute's levels with 95% confidence interval.

weight], 100% function (1.00; Standard Error (SE), .08); 80% function, (.42; SE, .08), while returning to only 20% of pre-injury function was the least desirable outcome (-1.18; SE, .09). Regarding short-term, 6-month reoperation risk, patients were indifferent in their preference of a 5% (.12; SE, .06) or 15% (.15; SE, .06) reoperation rate, but comparatively averse to 40% reoperation risk (-.27; SE, .06). Among the other attributes, patients preferred joint preservation (.18; SE, .04) to joint replacement (-.18; SE, .04), disposition home (.17; SE, .04) to rehabilitation facility (-.17; SE, .04), and immediate (.12; SE, .04) to delayed (-.12; SE, .04) weightbearing. No significant difference in the preferences for the long-term, 24-month reoperation risk was shown.

Although patients generally favored joint preservation, patients were willing to change their preference in favor of joint replacement or fusion procedure if it increased their function (as measured by return to baseline walking distance) by 13% (SE, .66). Patient preferences did not vary based on pre-injury function, history of joint replacement, or previous rehabilitation stay. There was also no variation in preferences of patients seen in our clinic with upper vs lower extremity fractures.

## Discussion

Our study, to our knowledge, is the first to quantitatively analyze what outcomes are prioritized by geriatric patients when presented with a lower extremity fracture. The results of our study supported our hypothesis that patients prioritize function above other outcomes when faced with a lower extremity fracture. Given their age and diminished functional status compared to younger cohorts, the goals of care when treating geriatric patients is often discussed as limiting complications rather than restoring function.

However, regardless of their baseline functional level, when choosing between the two hypothetical treatment options, the patients we surveyed overwhelmingly prioritized function over the other studied outcomes. Function was nearly 5 times more important in guiding the patients' choice of treatment than any other outcome. This data reinforce the importance to geriatric patients of maintaining and restoring function when treating geriatric lower extremity fractures. Although some goals of treatment can shift when treating older patients, our data argue that patients still value functional outcomes and these outcomes should continue to be assessed and prioritized when designing future trials investigating the treatment of geriatric lower extremity fractures.

Function preservation was strongly prioritized over other outcomes in our study; however, previous discrete choice experiments demonstrated the outcome most strongly prioritized by patients is decreasing mortality.<sup>19</sup> Haac et al. studied the patient preferences for venous thromboembolism prophylaxis after major extremity trauma. The authors found that mitigating the risk of mortality was exceedingly the most important factor in patients' decision making. Patients were willing to change their preferences for thromboembolism prophylaxis based on very small changes in the risk of mortality.<sup>19</sup> For this reason, we chose to exclude mortality from the studied factors to avoid mortality overshadowing all other treatment factors and possibly limiting the assessment of acceptable tradeoffs among the studied outcomes.

Early, 6-month, risk of reoperation was the second most strongly preferred outcome of the patients surveyed, while late, 24-month, reoperation was the least prioritized outcome. This suggests that patients strongly prefer avoiding reoperation within the 6 months after treatment of a lower extremity fracture and are less concerned with the risk of

reoperation in the long term. This data could also be important when considering the treatment of certain geriatric fractures where different treatment options can have different early and long-term reoperation risks, and different types of reoperations performed at those time points. The scope and scale of the reoperation, such as a minor implant removal vs conversion to arthroplasty, may also play a role in patient decision making but was not evaluated in our study.

Preservation of the native joint through fixation over joint replacement or fusion was the third most prioritized outcome studied (12%). Although patients preferred preserving their native joint over arthroplasty or arthrodesis, they were willing to change their preference for joint preservation if it provided a 13% increase in walking distance. These data again highlight the importance of regaining function after an injury, to this patient population. Arthroplasty is commonly performed for osteoarthritis among patients 65 years and older, and has been proven to be an effective treatment option for displaced intracapsular hip fractures in this population.<sup>13-16</sup> The widespread prevalence and success of joint arthroplasty likely makes this treatment option more favorable to geriatric patients.<sup>25</sup> We did hypothesize that a patient's personal experience with joint arthroplasty or fusion procedures would alter how they view these procedures for the treatment of a lower extremity fracture. Interestingly, we found no significant difference in preferences between patients who had a previous joint replacement or fusion procedure and those who did not. Given the mean age of the sample and the prevalence of joint arthroplasty among this demographic, it is possible that direct and indirect experience with joint replacement similarly affects lower extremity fracture treatment preferences.

The results of our study suggest that early weight-bearing was not strongly prioritized by patients. Despite this, previous studies suggest that the early mobilization after surgical treatment of geriatric hip fractures provides a mortality benefit. Therefore, while patients do not strongly prioritize the early weightbearing in and of itself, if a mortality or functional benefit can be demonstrated for the treatment of a lower extremity fracture in this patient population it should remain an outcome of importance.

Our study has some inherent limitations. As with any survey, patient preferences may have been limited or influenced by the patients' ability to comprehend the survey. For this reason, a research assistant explained the survey and was present to answer any questions as the patient completed the survey. Our study examines the 6 included outcomes of interest but provides no assessment of other outcomes or other treatment factors that may also be important to this patient population. Additionally, outcomes specific to individual fracture patterns or patient populations were not examined. The study was designed to

broadly assess the general outcomes that are prioritized by patients when faced with hypothetical lower extremity fracture. These 6 attributes were chosen based on those commonly assessed and relevant to geriatric lower extremity fractures, and further guided by expert opinion and pilot surveys. Another potential limitation is that we are presenting patients with a hypothetical scenario and treatment options. When faced with the reality and implications of a real injury and its treatment, patient preference may differ. Despite this, we found no significant difference in preferences among patients presenting to our clinic with isolated or multiple injuries, or upper or lower extremity injuries, suggesting that preferences may be consistent among different groups of patients. Surveying only patients with an acute fracture fitting the treatment parameters was not practically feasible. Due to the necessity to comprehend and complete the survey, we may have been more likely to enroll younger, more educated, and higher functioning geriatric patients, which might limit the generalizability of our study to those with advanced age, lower education and socioeconomic status, and poor mental status.

## Conclusion

Geriatric patients prioritize function over other outcomes after a lower extremity fracture. Joint preservation through fracture fixation is the preferred treatment of geriatric patients unless arthroplasty or arthrodesis provides a meaningful functional benefit. Factors such as early weightbearing, disposition, and late reoperation appear to be less important to geriatric patients. Future research studying the treatment of geriatric lower extremity fractures should seek to determine which treatment options maximize function and minimize early reoperation as these outcomes are prioritized by patients.

## Declaration of Conflicting Interests

N. N. O'Hara receives stock or stock options from Arbutus Medical, Inc. unrelated to this research. G. P. Slobogean receives research funding from the National Institute of Arthritis and Musculoskeletal and Skin Diseases of the National Institutes of Health, and serves as a paid consultant for Smith and Nephew and Zimmer, all unrelated to this research. R. V. O'Toole serves as a paid consultant for Stryker, receives stock options from Imagen, and receives royalties from Lincotek, all unrelated to this research. M. F. Sciadini serves as a paid consultant for Globus Medical and Stryker, receives stock options from Stryker, and receives royalties from Globus Medical, all unrelated to this research. The remaining authors report no conflict of interest.



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## Research ethics

The study was approved by the University of Maryland Institutional Review Board. All study participants provided written informed consent before completing the survey.

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